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(54) Airbag module

(57) An airbag module (20) includes an airbag (80) having a face panel (82) with a central opening (92) therein. The airbag has a rear panel (84) with a central opening (32) therein. The portion of the rear panel around the central in the rear panel forms a neck portion. A tubular insert (100) having an open end (102) is secured to the face panel about the first central opening. The tubular insert includes a closed end (104) opposite the open end and the tubular insert extends into the airbag.

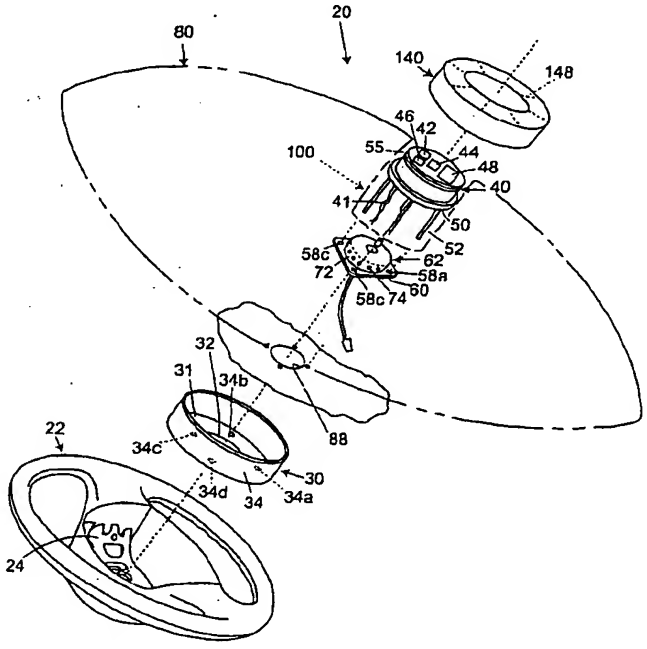


Fig. 1

EP 1 243 481 A1

Description

[0001] The invention generally relates to an airbag module having an annular or toroidal shaped airbag.

[0002] A typical driver's side airbag module comprises a housing, an inflator, an airbag and a cover mounted on a steering wheel. The inflator and airbag are located within the housing and the cover to protect the airbag. There is a benefit to placing various informational related devices on or near the center of the cover as this region is easy to see and easy to reach by the occupant, however. Because the cover is a sacrificial part of the module it is impractical to place permanent, and expensive, buttons, displays, switches and the like on the cover.

[0003] The present invention provides an airbag module comprising an airbag, the airbag including: a face panel having a first opening therein; a rear panel of substantially the same size as the first panel and having a central opening; a tubular member having an open end and an opposite closed end, the open end secured to the face panel along the first opening and wherein the interior of the tubular member is accessible through the slit.

Brief Description of the Drawings

[0004] FIG. 1 is an assembly view of a steering wheel and an airbag module that incorporates the present invention.

[0005] FIG. 1a shows an alternate plate-like housing.

[0006] FIG. 2 is an assembly view of an airbag of the present invention.

[0007] FIG. 3 is a cross-sectional view of an airbag with a tubular member within the center of the airbag.

[0008] FIG. 3a is a top view of an inflated airbag.

[0009] Figs. 4a and 4b show alternate configurations of a slit or opening used on a face panel of the airbag.

[0010] Figs. 5a-5b show a tubular center portion of an airbag.

[0011] FIG. 5c shows an alternate embodiment of the tubular center portion shown in Figs. 5a and 5b.

[0012] FIG. 6 is a partial cross-sectional view of a tubular center portion of FIG. 5b sewn to part of a face panel of the airbag.

[0013] Figs. 7-9 show an alternate construction of the airbag.

[0014] Figs. 10 and 11 show another embodiment of the invention.

[0015] FIG. 12 is a cross-sectional view of a module with a flat housing.

[0016] FIG. 12a shows an inflated airbag with the housing of FIG. 12 taken along section line 12a-12a of FIG. 3a.

[0017] FIG. 13 is a cross-sectional view of a module using a cup-shaped housing.

[0018] FIG. 14 is similar to FIG. 3 and includes a control module positioned within a tubular element or portion.

[0019] FIG. 15 is a cross-sectional view of an airbag module with an unfolded airbag extending radially outward.

[0020] FIG. 16 is a top view of an exemplary cover.

[0021] FIG. 17 is a cross-sectional view showing the airbag inflated.

[0022] FIG. 18 is a top plan view of a driver airbag module installed in a steering wheel.

[0023] FIG. 19 shows an alternate cover.

Detailed Description of the Invention

[0024] Figs. 1 - 4b illustrate a driver's side airbag module 20. The module is secured to a steering wheel 22 and more particularly to the hub, armature or center mechanism 24 of the steering wheel. The module can be secured or attached to the steering wheel in any acceptable way. For example, the module can be snapped into place or held in place directly or indirectly using threaded fasteners. Depending on the specific configuration, the module 20 may comprise a discrete, often cup-shaped housing 30 having a bottom 31 with central opening 32 and sides 34 to contain the folded airbag. Alternatively, the housing can be eliminated and the module can use the hollow cavity of the steering wheel hub area as a housing to protect the folded airbag, as shown in FIG. 1a. The shape of the housing can be varied, circular, triangular, or trapezoidal as needed. In FIG. 1a the housing is formed by a ring or generally flat plate, also referred to by numeral 30, having a central opening 32 and a plurality of stud-receiving openings 34a-34d as shown in FIG. 1. The module additionally includes a control module 40, as shown in FIG. 1. As shown, the control module 40 is circular but can be varied shapes and sizes, for example as shown in FIG. 18.

[0025] The control module 40 may house signal conditioning electronics within a housing portion thereof. An upper surface, which may be flat or contoured, of the control module 40 can support one or more informational devices such as displays or mechanisms such as a horn switch 42, radio buttons 44, a navigation system 46 and its associated display 48, and so forth. Electric wires 41 can carry signals to and from the control module 40. The module 20 further includes a cover 140 and an inflator 62, which inflates the airbag 80, which is only partially shown in FIG. 1. The specific shape of the housing, control module and cover will vary with each application. Generally, the sides of the housing and cover will cooperate with the control module 40 to create a covered, annular trough, which extends about the control module 40 and in which the folded or compressed airbag is located. This trough may be circular, triangular, oval, etc. as dictated by performance and styling considerations and the shape of the housing, cover and control module.

[0026] The control module 40 includes a plurality of threaded mounting studs 52, which extend from a bot-

tom 50 of th control module 40. These studs extend through openings 58a-58d in th flange 60 of an inflator 62, as well as through various openings 84a-84d in the neck portion 67 of th airbag 80, as well as through a tubular portion 100 of the airbag 80. The inflator includes a plurality of exit ports 74 through which inflation gas is communicated to the airbag. The mounting studs 52 can also extend through openings in the hub of the steering wheel as one means of fastening the module to the steering wheel and then fixed in place by fasteners such as nuts 53, as best shown in FIG. 13.

[0027] FIG. 12 shows an alternate construction in which each fastener 52 of the control module 40 is secured to a snap-fit connector 53a that also acts as a nut holding the various parts of the module 20 together. The tapered tip of fastener 53a permits the module to be easily inserted within or snapped into the steering wheel when using a cooperating snap-fit fastening or receiving part of known construction. FIG. 12 also shows the use of the flat-plate housing 30. In this configuration the cover 140 includes opposing side tabs 240, which envelop the underside of the housing 30 and which are sandwiched between the inflator flange 60 and adjacent portions of the housing. The neck 67 of the airbag is sandwiched between the flange and the housing.

[0028] FIG. 13 is a cross-sectional view of the module shown in FIG. 1 with the circular, walled housing 30. The neck portion 67 of the bag is also clamped between the housing bottom 31 and an inflator flange 60. These studs also extend through other openings in a bottom portion of a fabric tube 100, which is part of the airbag. This bottom portion 104 is clamped between the bottom of the control module 40 and a cooperating part of the module such as the inflator, ring, housing, etc.

[0029] Figs. 2, 3, 4a and 4b show the major components of the airbag 80. The airbag comprises a face panel 82, which in the illustrated embodiment is circular, and a similarly shaped rear panel 84. The front and rear panels are sewn together along a peripheral seam 86. Panels that are of other shapes including oval or rectangular are within the scope of the present invention. The panels will typically be made from woven nylon. The rear panel 84, at its neck 67, includes a center opening 88, which is located interior to the mounting openings 84a-84d, and also in the neck 67.

[0030] In Figs. 2 and 3 the neck area can optionally be reinforced by a number of small panels 87a, 87b that may be any convenient shape including oval, round or rectangular. One or both of these panels 87a, 87b also act as a heat shield, shielding the panel 84 from the heated gas provided by the inflator 62. Each panel 87a, 87b also includes a center opening 88 as well as fastener openings, which are also identified by numerals 84a-d. The panels 84, 87a, 87b are sewn together, as at the seams 86a, with the respective center openings 88 and the respective fastener openings in alignment as shown in FIG. 3. After the airbag is construct d, the inflator 62 is, partially or compl tely, placed within the airbag through p ning or penings 88, which includes the composite of the align d openings 88, so that the exit ports are inside the bag.

[0031] The face panel 82 includ s a slit 92 that splits th face panel into facing sides or elements 92a, 92b. The ends of th slit 92 can include stress-reducing features if needed such as small, circular cutouts 94, as also shown in FIG. 4a. The sides or elements 92a, 92b are preferably separated only by the thickness of the instrument used to slit the face panel. In FIG. 4a the slit has a determinable, though narrow, width and in FIG. 4b the slit is oval shaped with its sides 92a, 92b spaced apart a greater distance. In FIG. 4a, the spacing between the sides 92a, 92b of the slit is about 1 mm and a typical length of the slit is in the range of 120 mm to 180 mm. As will be seen below the slit 92, of the flexible face panel 82, will be pulled apart to permit the control module 40 to be inserted into a center tubular member 100 of the airbag. The length of the slit or opening 92 should be of sufficient size so that the effective opening, achieved when the sides of the slit 92 are separated, is large enough to permit the control module 40 to be inserted therein.

[0032] As mentioned above, the tubular portion 100 is secured about the slit 92. The generally tubular p rtion 100, as shown in FIG. 2, is formed with an open end 102 and a closed end 104, as shown in Figs. 2, 5b and 6, and has a cylindrical body. The tubular portion 100 can be made from one or more pieces or panels of material or can be formed as a one-piece woven sock-like structure, having an integrated bottom and sides and an open mouth or top. FIG. 2 shows one such center p rtion 100 positioned apart from the face panel 82. Figs. 5a-5c show the construction of the center portion 100 in greater detail. An alternate embodiment of the portion 100 is shown in FIG. 5c.

[0033] In FIG. 5a the center portion 100 is formed by a flexible, woven core panel 110, which is symmetrical about a centerline 112 and includes sides 114a, b, a top 116 having two arched sections 116a, 116b and a straight bottom 118. While the sides 114a, b of the center portion are parallel in this embodiment, they can be angled as shown in FIG. 5c. Positioned below the core panel 110 of FIG. 5a is an end panel 120, which can be formed of a woven, flexible material, and in this embodiment the core panel is circular. In FIG. 5b the core panel 110 has been folded or rolled over the centerline and the sides 114a,b sewn together along a sewn seam 114c. Thereafter the end panel 120 is sewn to the bottom or end 118 of the core panel, closing this end, to form the tubular center portion 100, as shown in FIG. 2. The end panel 120 also includes a plurality of openings 122 a-d. Each of the panels forming the tubular portion 100 is formed of a flexible fabric, which as mentioned can be woven and can be coated or uncoated depending on the need to control the air permeability of the panels and to contr l th heat shielding eff cts. The flexibl mat rial permits th central portion 100 to be pulled,

bent and twist d and in a sense m lded to the shape n ed d. In its assembled configuration, the bottom 120 or closed end 104 of the center portion 100 will be positioned adjacent an inflator 60. Optionally, one r more heat shields 126, 126a formed by thick and/or coated, fl xibl fabric panels can be sewn to or incorporated as the end panel 120. In this manner heated inflation gas does not directly impinge on the bottom panel. The heat shield 126, if used, includes another set of openings 124a-d that are aligned with the set of openings in the end panel or bottom 120.

[0034] Having formed a tubular center portion 100, it is now connected to the face panel 82. More particularly, the top arched sections are sewn peripherally about and slit with section 116a sewn to side 92a of the slit and the other top arched section 116b sewn to side 92b of the slit. The length of the slit 92 is the same as the distance from point A to point B measured along a curved arched section 116a or 116b, as shown in FIG. 5b.

[0035] FIG. 6 shows a cross-sectional view of the face panel 82 with one side 92a of the slit sewn to one of the arched sections such as 116a, the seam being designated by numeral 126.

[0036] The bottom of the tubular portion 100 will be fixed in place by the inflator 62. FIG. 6 shows the relative positions of the tubular center portion 100 and the face panel 82 when the airbag is inflated. Portions of the face panel near points A and B of the tubular center portion 100 will be maintained closer to the bottom 104, that is to say the inflator, of the center portion 100, and also act as a tether as this construction limits displacement toward a vehicle occupant of the face panel 82. The shortest dimension of the center portion 100 is along the sewn seam 114c, as well as region 114d that is generally opposite the seam 114c. Since the seam 114c in this construction is located at the tether, during inflation the sewn seam will be tensioned. Some of the following embodiments reposition the location of the sewn seam 114c, so that it is not at the shortest part of the core panel and therefore will not be subjected to as much tension.

[0037] Figs. 7-9 show another embodiment of a tubular center portion 100a. The core panel 110a includes arched portions 116c, 116d, which are concave in shape, as opposed to the generally convex shape of the arched sections 116a, 116b. After the sides 114a, 114b are sewn together the shortest portions, those which act as a tether, of this center portion 110a have been moved away from the sewn seam 114c. When the airbag is inflated, and the tubular portion 100a is stressed, the maximum stresses will no longer lie along the sewn seam 114c. FIG. 9 shows the alternative center tubular portion 110a sewn to the face panel 82 and along a seam 126.

[0038] Figs. 10 and 11 show a further embodiment of a tubular center portion 100c. The portion 110c is made of one piece of fabric as opposed to two panels. An assembled one-piece core panel 110c forms the bottom and sides of th tubular portion. C re pan l 110c will also includ the penings 122a-d previously f und in the bottom panel 120. The core panel 110c is folded ver centerline 112 and side portion 114a is sewn to portion 115a and 114b sewn to 115b. Panel 110c includes additional openings or slits 117 near the intersection of each side and centerline 112, which facilitates sewing of the panels 110c. The ends 116a, 116b of the panel 110c are arched and, as with the embodiment of FIG. 2, are sewn to opposite sides of the slit 92. Benefits of this construction are that the heat shields, if used, can be positioned upon the core panel 110c while the core panel is still flat and the heat shields tack sewed very easily. Both the core panel and the heat shields can include odd-shaped openings 115. When the corresponding openings 115 are aligned, the heat shield is properly positioned both linearly and angularly prior to sewing. Thereafter the mounting openings or holes 122a-d can be punched therethrough in one operation insuring alignment of these holes and the core panel sides can be sewn quite easily giving the tubular portion its shape. While not shown, the tubular member, portion or element 100 can be formed as a one-piece woven sock with an integral bottom, sides and open top. The fastener holes can be formed during weaving or subsequently cut or burned out.

[0039] In FIG. 14, which is similar to FIG. 3, the tubular central element portion 100 is located between th sewn-together face and the rear panels. The configuration of the airbag would be similar with the other tubular portions 110b or 110c. Thereafter, the sides of the slit 92 are pulled open and the control module 40 is moved to the bottom or the portion 104 or to the end panel 120, and each of the fasteners 52 is received through one of the fastener openings 122a-d, in the bottom 104 and heat shields, if used. Thereafter the inflator 62 is placed into the airbag through the opening 88 in the rear panel as also shown in FIG. 14. The fasteners 52 also extend through one of the openings 58a-d in the flange 60 of the inflator 62. The top of the inflator 62 sandwiches the bottom 104 of the tubular member 100 against the bottom of the control module 40.

[0040] Thereafter, each stud 52 is received in one of the openings 64a-64d about the neck 67 of the rear panel 84. The neck of the rear panel lies adjacent and below the bottom of the inflator. Finally the housing 30, whether cup-shaped or flat, is positioned on the studs sandwiching the neck portion of the rear panel against the flang of the inflator. The various parts of the module 20 can be secured in place by respective threaded nuts 53, or fasteners 53a, to achieve the configuration shown in Figs. 12 or 13. The same or different nuts or fasteners can be used to secure the housing, inflator and control module to the steering wheel 22 as shown in FIG. 1.

[0041] Prior to folding the airbag 80, the face panel 82 is pushed downward so that the slit 92 is located about the side of the control module. Thereafter, prior to folding, the airbag 80 can be positioned to extend outwardly over th sides of the housing 30 as shown in FIG. 15. Subsequently, the airbag 80 is f ld d to reside within

th annular space 130 betwe n th int rior surfaces of the housing, the inflator and contr l module 40, and th cover 140 secured about th control module 40 and to th housing 30. Alternatively, the cov r 140 can first be attached to th control modul 40 and the airbag folded into the space between the control m dule 40 and the cover. Thereafter, the housing 30 is secured in place about the folded airbag and held in place by to the fasteners 53 or 53a.

[0042] In Figs. 1 and 13 the control module 40 includes a peripheral groove 55, which is used to secure a center opening 146 of a cover. For example, after the airbag is folded it is covered by a cover 140. A top view of the cover is shown in FIG. 16. In one embodiment, the cover 140 is annular shaped and comprises a cylindrical outer wall 142 with a flat annular top 144 having a center hole 146. The diameter of hole 146 is smaller than the diameter of groove 55 so that the lip 147 about the opening 146 can slip within the groove and be secured thereby. The cover 140 additionally includes a plurality of generally radial tear seams 148. Alternatively, for example, the cover 140a, as shown in FIG. 19, may include a center opening 146 with first and second radially directed tear seams 148 extending from about the 90 and 270-degree points, or 0 and 180 degree, about the center opening. The opposite ends of the radially directed tear seams are connected to respective straight or modestly curved tear seams 148a. Each of these tear seams 148a can be oriented generally horizontally or vertically. As the airbag is inflated the lip 147 is pulled out of the groove 55 and the cover tears along each tear seam 148, which permits each sector or segment 144a of the cover to move or pedal outwardly, permitting the airbag to exit about the open annular spacing between the now opened cover and the control module.

[0043] FIG. 17 shows the airbag 80 inflated. The face and rear bag panels form an annulus centered about the control module. As the airbag inflates, the pressure internal to the bag acts on the walls of tubular element or portion 110, 110a, 110b, urging the sides 92a,b of the slit or opening 92 closed. An inflated airbag is also shown in FIG. 12b. The airbags of Figs. 17 and 12b are the same but the housings and cover vary. The view of FIG. 12b is 90 degrees from the view of FIG. 17.

[0044] In the embodiment shown in FIG. 12 the control module 40 includes a flange 55a, which replaces groove 55. Additionally, the cover 140 includes a recessed flange 55b, which fits beneath the flange 55a.

Claims

1. An airbag module (20) comprising an airbag (80), the airbag including:

   a face panel (82) having a first opening (92) ther in;
   a rear panel (84) of substantially the same size as the face panel and having a central opening (32);
   a tubular member (100) having an open end (102) and a closed end (104), the open end is secured to th face panel along the first opening and wherein the interior of the tubular m mber is accessible through the slit.

2. The airbag module (20) of Claim 1 wherein the first opening (92) is a narrow slit.

3. The airbag module (20) of Claim 1 wherein the first opening (92) is oval.

4. The airbag module (20) of Claim 1 wherein the first opening (92) is rectangular.

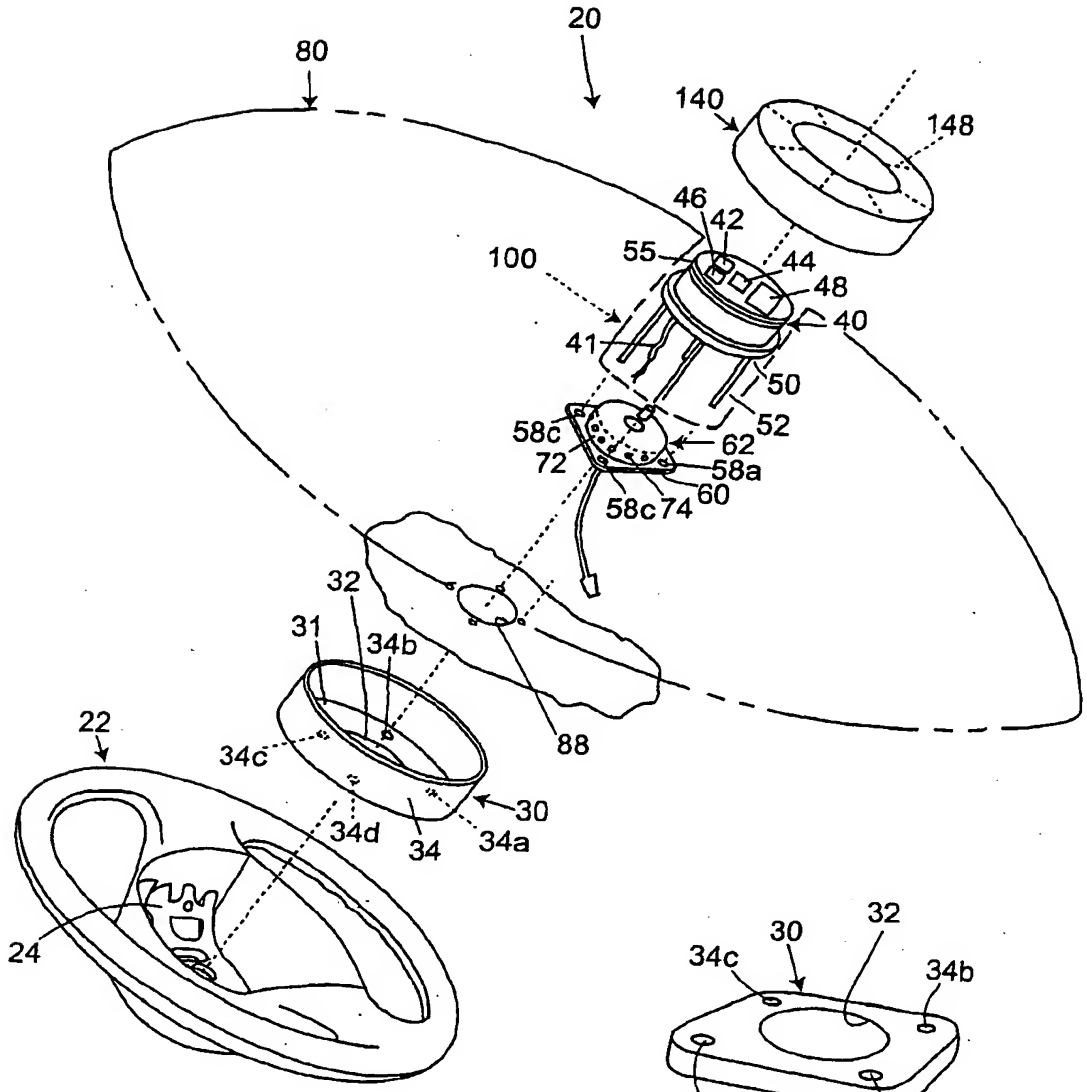
5. The airbag module (20) of Claim 1 wherein a contr l module (40) is located in the first opening (92).

6. The airbag module (20) of Claim 5 wherein the tubular member (100) includes a bottom and wherein the bottom of the tubular member is located between the bottom of the control module (40) and an inflator (62).

7. The airbag module (20) of Claim 6 wherein the bottom of the tubular member (100) is sandwiched between the control module (40) and the top of the inflator (62).

8. The airbag module (20) of Claim 7 wherein the airbag in a folded state is located about sides of the control module (40) and covered by a cover (140).

9. The airbag module (20) of Claim 6 wherein the inflator (62) does not protrude out from the airbag (80).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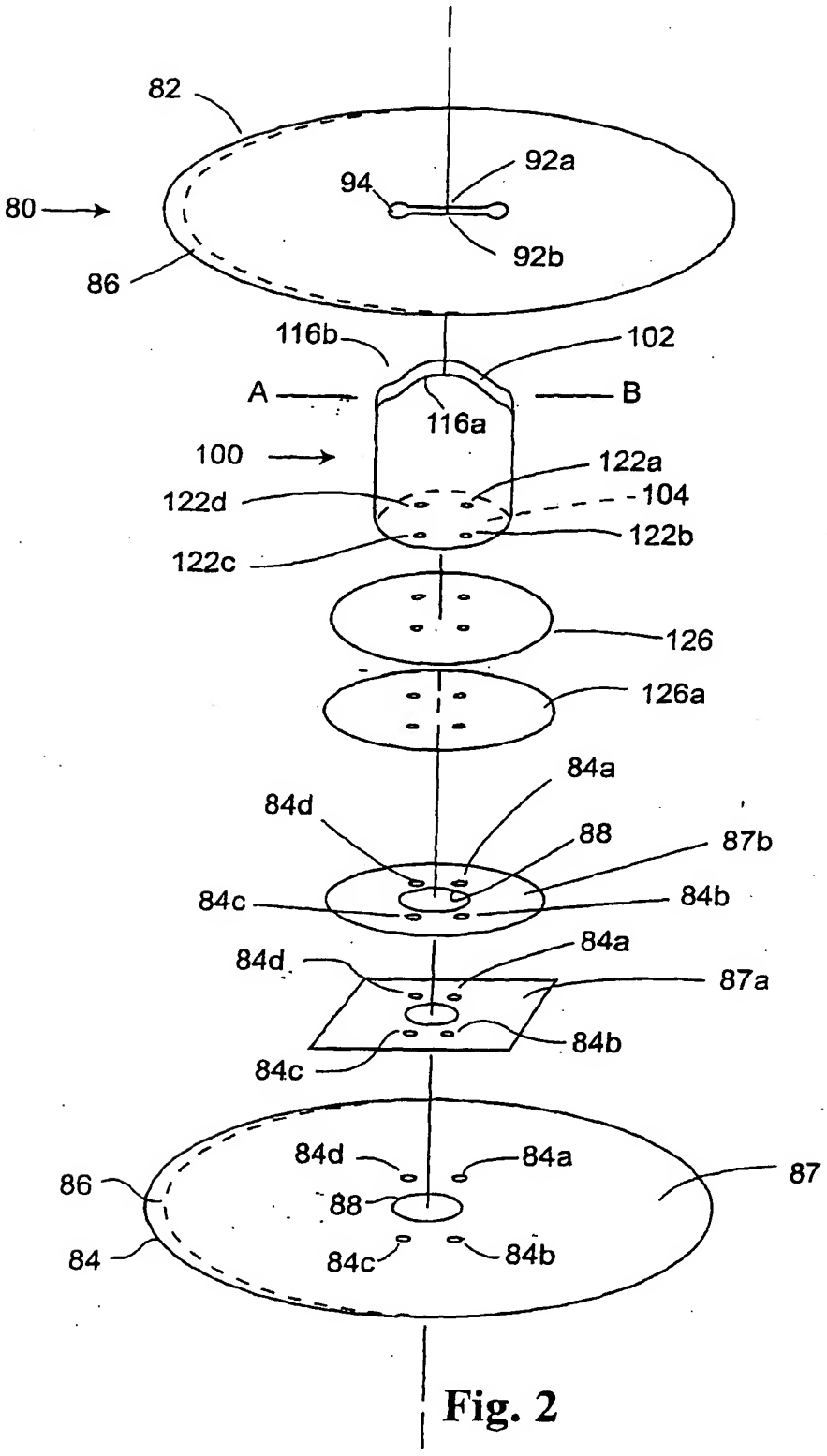
80
140
148
46
42
55
44
100
48
40
41
50
52
58c
62
72
58a
58c
74
60
32
31
34b
22
34c
88
30
34d
34
34a
24

Fig. 1

30
32
34c
34b
34d
34a

Fig. 1a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80
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92b
86
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A
B
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100
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122d
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84d
88
87b
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Fig. 2

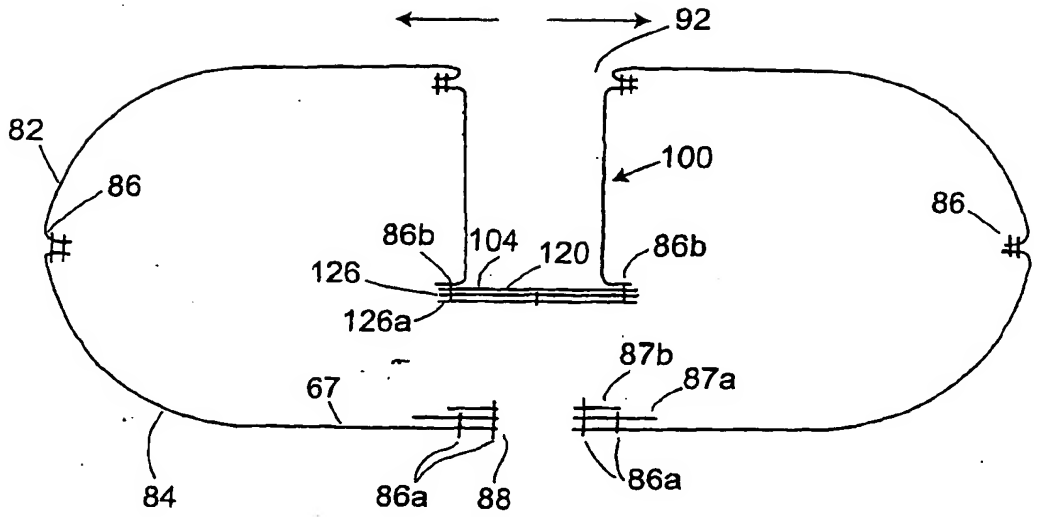

Fig. 3

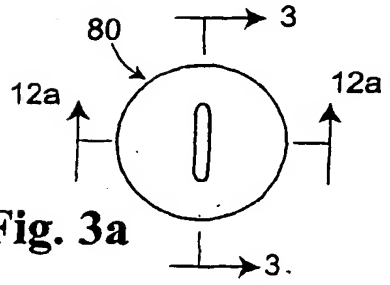

Fig. 3a

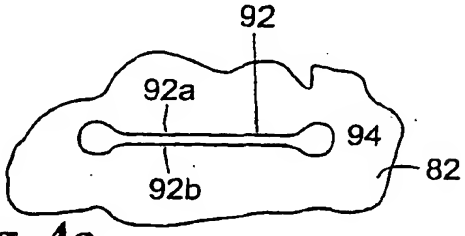

Fig. 4a

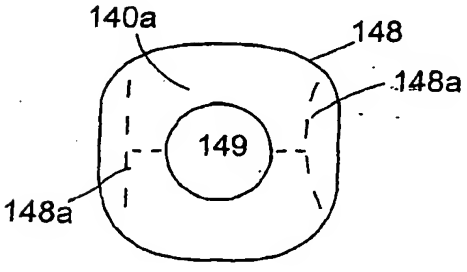

Fig. 19

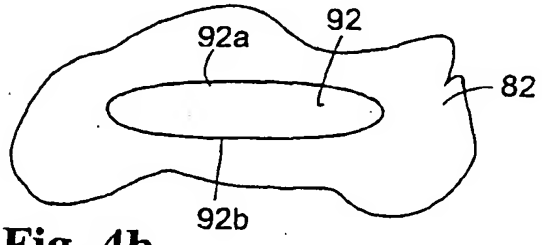

Fig. 4b

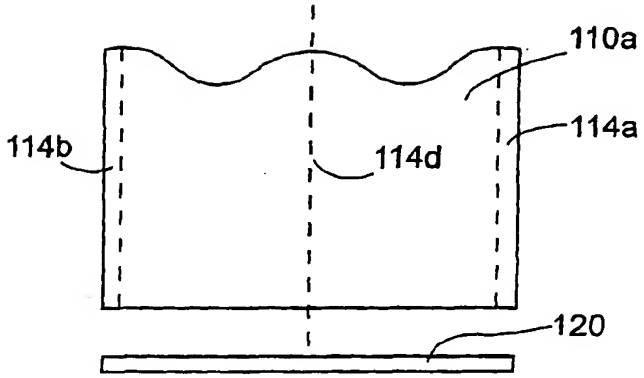

Fig. 7

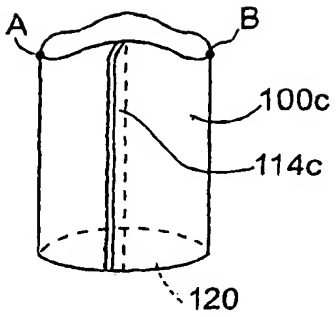

Fig. 8

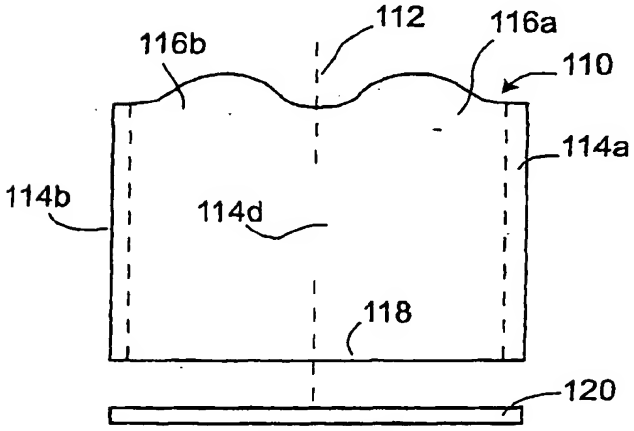

Fig. 5a

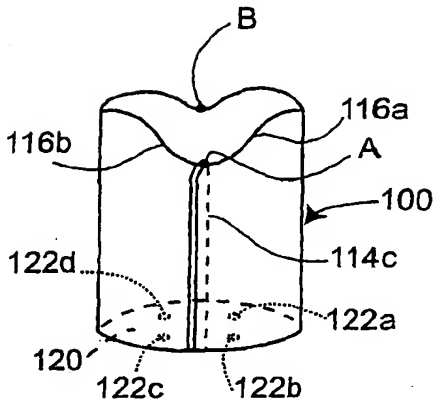

Fig. 5b

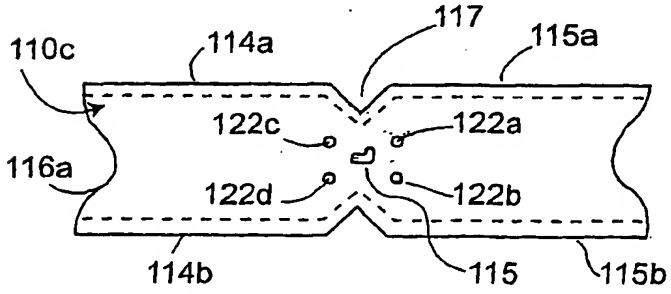

Fig. 10

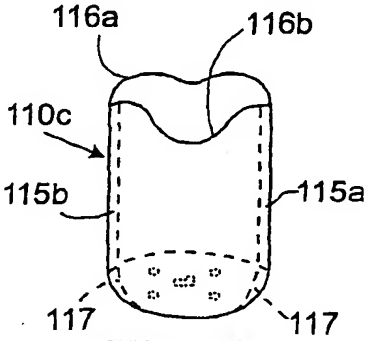

Fig. 11

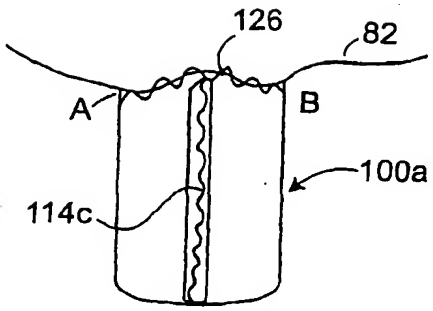

Fig. 9

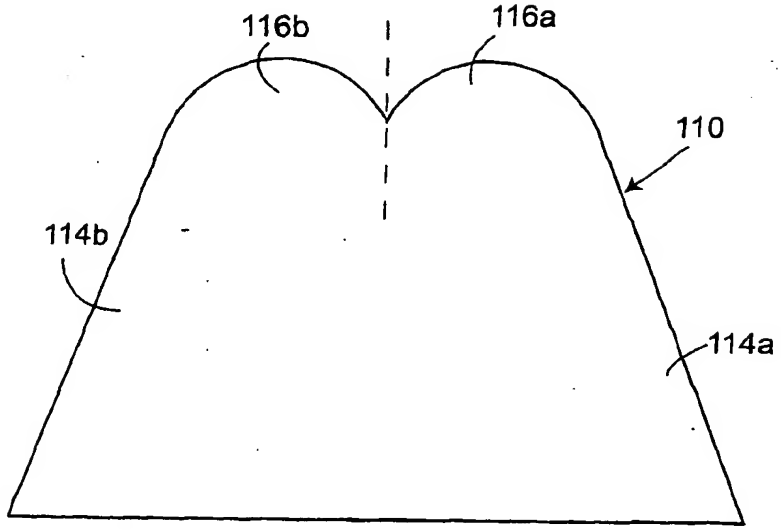

Fig. 5c

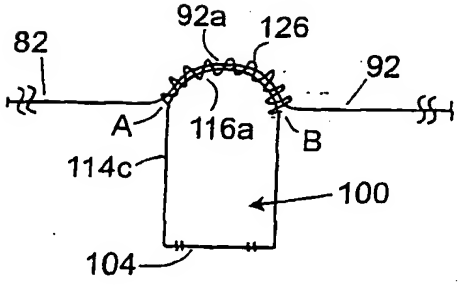

Fig. 6

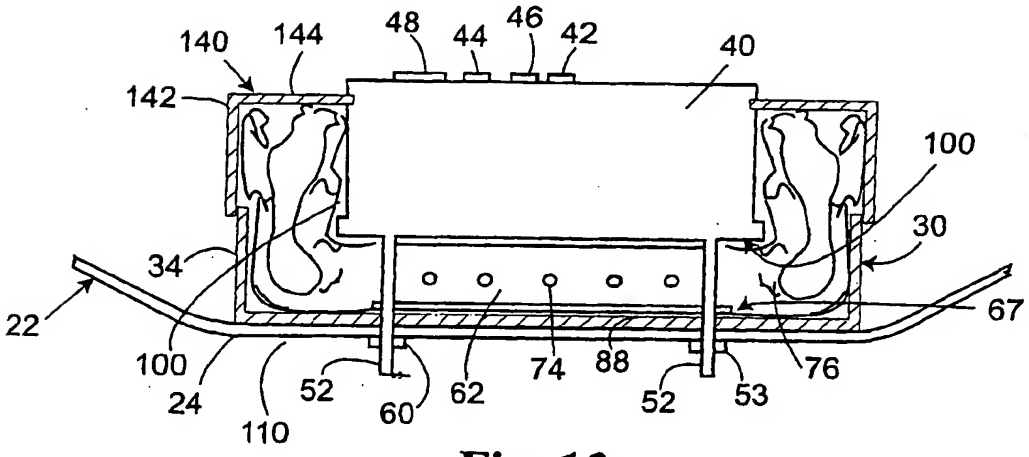

Fig. 13

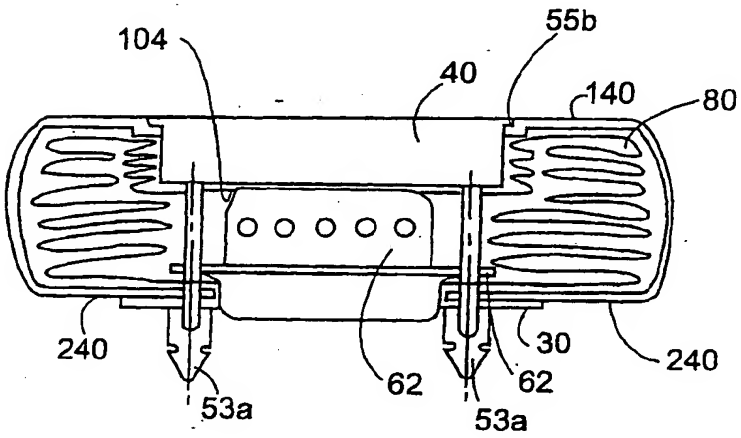

Fig. 12

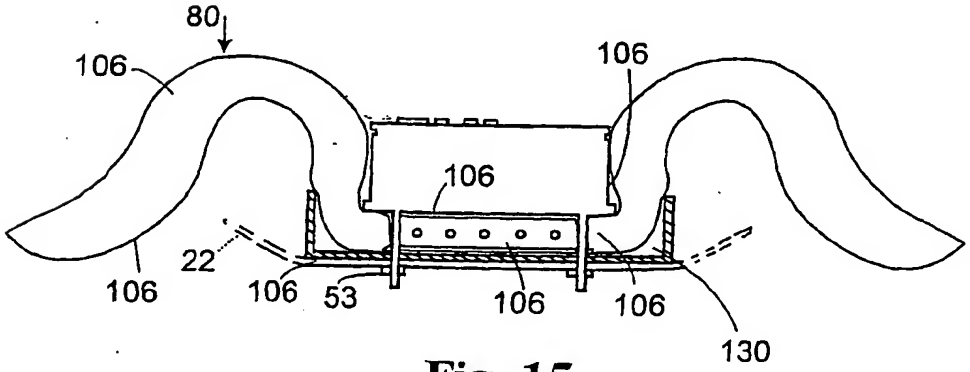

Fig. 15

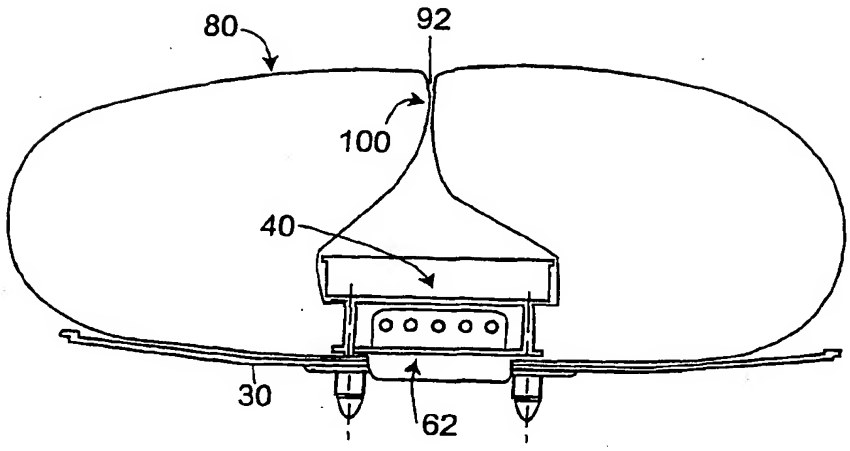

Fig. 12a

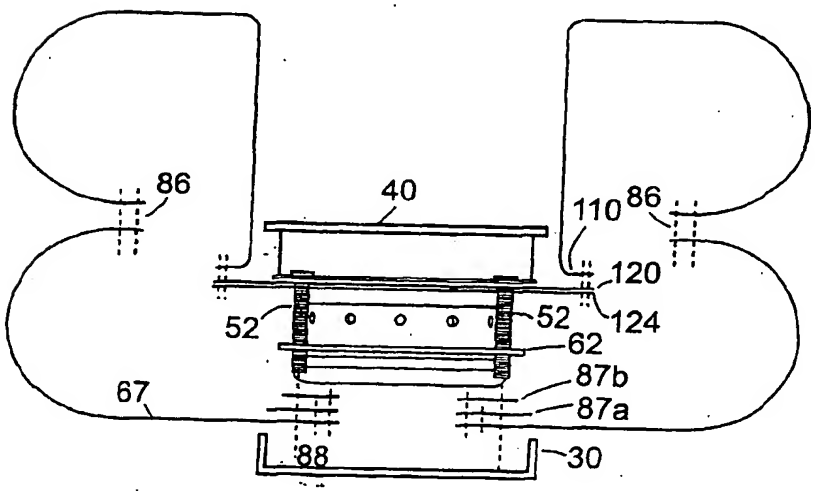

Fig. 14

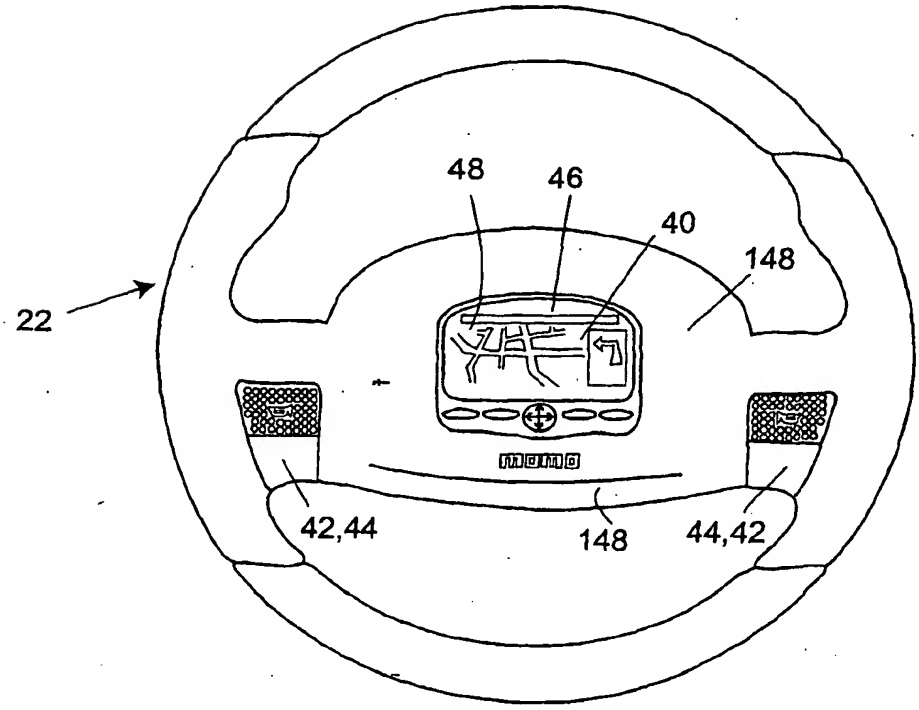
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Fig. 18

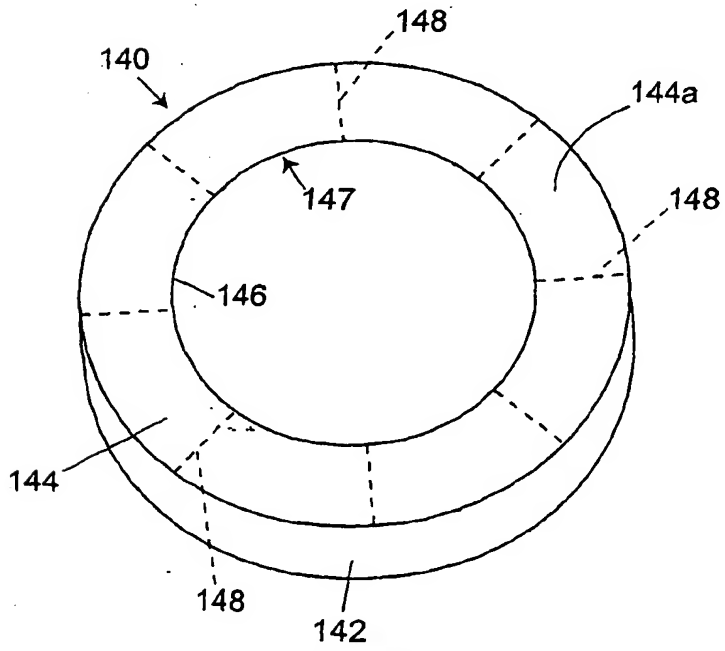
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Fig. 16

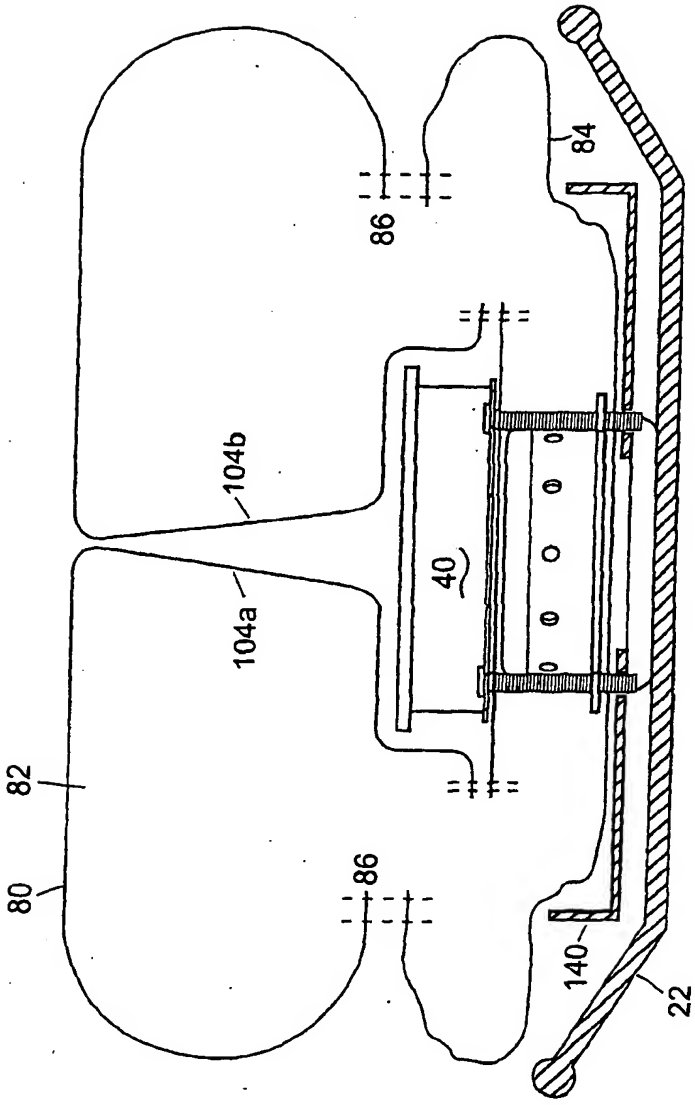

Fig. 17

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Place of search	Date of completion of the search	Examiner
MUNICH	24 July 2002	Lecomte, D

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